

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Light Metals

THE story of the lighter metals and alloys, which are the subject of a special article in our metallurgical supplement this week, is in many ways typical of the modern trend of industry. It is a story of pure research, which later developed into industrial utilisation, and brought with it the apparently inevitable aftermath of power politics—an aftermath that is one of the objectives of the Churchill-Roosevelt declaration to remove. The industrial light metals and alloys are built round aluminium and magnesium, though, of course, other metals enter into the alloys that are now known to metallurgists. Their history begins with the isolation of magnesium by Davy in 1803, and of aluminium by Wöhler in 1827. For many years they were scientific curiosities and when ultimately industrial uses were seen to be possible, the difficulties of production and the high cost of the metals prevented their use in competition with established materials. Nevertheless, it was inevitable that metals with such low densities (magnesium 1.75, aluminium 2.67) should find a use, and with that use would come means for economic production.

New possibilities were opened to metallurgists and engineers in 1909 when the first magnesium base alloys proper were exhibited under the name of "Electron Metal" at the International Aircraft Exhibition at Frankfurt, thus providing industry—and the aircraft industry in particular—with a new constructional material having a sp. gr. of 1.8. Very small quantities were required, however, at first and many improvements had to be made before these alloys became commercially practicable with physical properties suitable for engineering purposes. The company which first developed these magnesium alloys was one of the parent concerns of the I.G. Farbenindustrie, and that company controlled world production. So far as can be ascertained the total world requirements of magnesium metal in 1930 (partly due to the industrial depression) were but 1000 tons. This was almost wholly produced by the I.G., the remainder being a small amount made in the U.S.A. for home consumption only. The foundation of a modern magnesium factory entails possession of many years of experience of large-scale electro-chemical production plants, supported by an equally extensive experience in the control of production from the ore, and in the design of apparatus and plant. Unless opportunity was provided for obtaining the necessary experience, no other country, no other company, could hope to compete with the I.G. Possession of the world market would effectively limit the possibilities of competition. Thurman Arnold, Assistant Attorney-General of the U.S.A., writing in

the *Reader's Digest* for August, has pointed out that the I.G. and the Aluminium Company of America held patents necessary for the production of magnesium, and that Germany for political reasons wished to increase her own production of magnesium, keeping that of the rest of the world low. Similarly, the Aluminium Company, he states, desired to control the production of magnesium so that it would not compete with their own major product—aluminium. "These separate desires worked towards a common end. The German Dye Trust and the Aluminium Company of America pooled their patents. They agreed that not more than 4000 tons could be produced in America. They limited shipments to England to 300 tons a year. They allowed only one American firm, the Dow Chemical Company, to make magnesium. And so it was that before 1940 American magnesium production never exceeded 2500 tons. When war broke out England was dependent on her enemy for 35 per cent. of her magnesium needs." These statements, made under the name of a high authority of the legal department of the U.S.A., the Head of the Anti-Trust Division of the Department of Justice, illustrate a phase of the international chemical industry not generally made public.

However, by 1939 the world production of magnesium had reached 32,000 tons of which 2500 were produced in the U.S.A., 5000 tons in England, and 20,000 tons in Germany. The British Empire is going ahead rapidly, and the St. Lawrence Power Scheme, which has been brought to fruition through war pressure, will further assist the production of light metals and alloys by providing cheap water-power, designed to produce 2,100,000 h.p.

Among the industrial applications of magnesium and aluminium and their alloys the uses for aeronautical work stand pre-eminent. Wherever lightness is essential these alloys will be required. Magnesium metal is usually produced in the form of die-castings and can be used when it is chemically and physically suitable and when bulk production of castings is possible in the light of demand. There are very many uses in the motor industry, e.g., for oil-pump housings and covers, gear-box covers, oil-filter bodies, supports for pressure gauges and lamps, gear parts and boxes, bearing blocks, and so forth. Many typewriters are largely constructed of cast magnesium; it is used in the optical and electrical industries; and in short, there seems to be no limit to the uses of the light metals and their alloys. They are of fundamental importance in peace and war. British production must be maintained after the war.

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NOTES AND COMMENTS

The Development of Beryllium

THE orderly steps from scientific curiosity to industrial importance which have been described in our leading article as having taken place with aluminium and magnesium are also in motion with regard to beryllium. The beryllium minerals are comparatively scarce, though fairly widely distributed. Within recent years further sources of supply have been discovered and there is now known to be sufficient to warrant industrial production. Interest was displayed in beryllium before the war, and it appeared likely that it would find extensive use in general engineering in the same way as have other light metals. With a specific gravity of approximately 1.9 its density is very similar to that of magnesium. The high hopes originally entertained of the industrial importance of beryllium have not yet been realised; in many quarters it has been felt that they never would be realised. There is now, however, every reason to believe that this metal will retrieve its lost position in a surprisingly short space of time. The difficulties of treatment are being overcome and the cost, which was formerly a very serious item, is being reduced. Authorities in the light metal industry suggest that before long this metal will be brought to a stage where it can compete on a satisfactory price basis with other standard heavier materials of construction, and for certain purposes with metals and alloys of its own class.

Metals for Compression Ignition Engines

LIGHT constructional materials are highly desirable for the smaller types of sea-craft and for commercial vehicles while they are an essential characteristic of aero-plane engines. The compression ignition engine involves high peak pressures which tend to put high pressures upon the engine components. For this reason there is difficulty in visualising the use of softer metals such as aluminium and magnesium for the work. Nevertheless, metallurgists have devised alloys based upon aluminium and magnesium, which can be satisfactorily utilised for engine construction. They also possess superior thermal properties, advantage of which may be taken in design, making feasible the attainment of qualities quite as desirable as that of minimum dead weight. Utilised in engine construction, aluminium alloys have rendered possible three improvements:—

- (1) A reduction in the weight of reciprocating parts, thus reducing the inertia losses.
- (2) The reduction of dead weight, thus enabling a greater load to be carried.

- (3) The more effective dissipation of waste heat by reason of the high thermal conductivity of these alloys.

A light alloy engine construction can now be evolved weighing not more than half of that required for cast iron, and there are in operation engines largely constructed in aluminium, weighing only 30 per cent. of the original cast iron design.

Modern Theories of Plasticity

PLASTICITY of clays, as we noted last week, is a subject as yet incompletely developed. But there is possibly a link between the water in the clays and the silicate surface. The late Dr. Mellor believed that the clay particles are separated by water films, which decrease in thickness as drying proceeds, and finally cease to shrink when the particles come into contact. In general when the clay is dried to between 8 and 12 per cent. of water there is little subsequent change of volume on further drying. Mellor's ideas have been generally adopted in the clay industry until recently when the idea of a water film, which implies a binding of the liquid to the solid surface, has been replaced by the slightly different view that the separation of the surfaces is due to a repulsion between them; this repulsion is estimated by determination of the equilibrium moisture content when the mixture is compressed under constant load between porous pistons. In order to account for the observed rates of flow of water through plastic clay, Mr. Macey has put forward the supposition that there exists in the water near the clay surface a tendency towards regular arrangement. This regular structure is built up of layers of water in crystalline form, and decreases with distance from the surface. The rate of destruction of this arrangement with distance from the surface, by thermal agitation and the presence of ions, may reasonably be expected to be proportional to its value at any point. Two such systems, based on opposing surfaces, necessitate mutual destruction at the midway point and energy will be required to bring the surfaces closer together. This appears as a repulsion between the surfaces increasing as the separation decreases. The rigidity of the plastic body is due to this network of repulsive forces. The increase in the magnitude of the forces with decrease in moisture content results in the well-known hardening of clays. On application of shear the particles slide over one another, but on its removal a similar force system remains, and the material is capable of retaining its deformed shape. It will be understood from this brief description of the views of physicists that the plasticity of clays is a subject of considerable complexity. It is not therefore surprising that there is an alternative theory of structure, due to Terzaghi, which holds that the clay particles are in contact at certain points, and build up into a honeycomb or interlocking series of bridges, formed by the smaller particles between the larger. No critical experiment has yet been devised on which a decision between these two quite dissimilar theories can be made.

Preparation of Nitriles

A New Method Using Acid Amides

ACCORDING to Y. S. Gwan, University College, Rangoon (*J. Ind. Chem. Soc.*, 1941, 18, 3, p. 164), *p*-toluene sulphonyl chloride may be used as a dehydrating agent in the preparation of nitriles from acid amides. The advantage of the process is that the yield is better and the reagent is less drastic. Benzamide (12 g.) and dry *p*-toluene sulphonyl chloride (19 g.), were intimately mixed and heated under reflux at 130°–135° C. in an oil-bath for 1½ hours. The mixture was then distilled in steam for the isolation of benzonitrile, which was then redistilled (7.3 g.). *p*-Toluene sulphonic acid can be recovered from the non-volatile residue.

Similarly, acetamide (10 g.) gave with *p*-toluene sulphonyl chloride (31 g.), after interaction and isolation in the manner described, 5 g. of acetonitrile.

The Chemistry of Castor Oil*

Influence of the Hydroxyl Group

VEGETABLE oils—such as coconut, palm, cottonseed, and linseed oils—have for many years occupied an essential position in industry as raw materials. A fundamental knowledge of their composition has allowed organic chemists to convert these naturally occurring triglycerides into a multitude of useful products. Among them might be mentioned the production of edible fat from cottonseed oil by hydrogenation and the manufacture from coconut oil of the higher aliphatic alcohols used to make the so-called soapless detergents. All the commonly used vegetable oils consist almost entirely of the triglycerides of long-chain aliphatic acids. Most of these acids contain seventeen carbon atoms plus the carboxyl group, and they differ from oil to oil principally in the number of olefinic bonds. For example, linseed oil contains a relatively large number of olefinic linkages and is a good drying oil for paints, while olive oil, with less unsaturation, is unsuited for such a purpose. Since the differences between vegetable oils are largely produced by variations in the number of double bonds, complete hydrogenation of the various oils should lead to similar types of hardened fats.

One of the most commonly used vegetable oils, castor oil, differs from others in that it contains a hydroxyl group in addition to an olefinic linkage in its predominating fatty acid. Ricinoleic (or 12-hydroxy oleic) acid forms about 80 per cent. of the total fatty acid content produced on saponification of castor oil. The structure of ricinoleic acid is as follows:



The introduction of the hydroxyl group into the fatty acid chain gives castor oil many unique and interesting properties, both physical and chemical. One important physical property is viscosity, which is considerably higher than that of other fatty oils. Since viscosity is a measure of the ease with which the molecules are able to slide past one another, it seems likely that the hydroxyl groups may protrude from the fatty chains in such a way as to impede their free flow. Another extremely important physical property is solubility in various types of solvents, which in the case of castor oil is quite different from that of other fatty oils as a class. Castor oil tends to dissolve in oxygenated solvents like alcohols and not to dissolve in hydrocarbon-type solvents, while the reverse is true of other fatty oils. This peculiarity is also attributable to the presence of the hydroxyl group. From the synthetic point of view ricinoleic acid and castor oil have come to be considered as indispensable raw materials for a great many industrial applications in which no other fatty material could be used with equal success. We shall see that many of these can be traced to the presence of the hydroxyl group.

Artificial Leather Manufacture

To the uninitiated the major outlet for castor oil is often thought to be medicinal. But the following estimate, covering the period 1918-38, indicates that this accounts for only a minor portion of the total consumption:

Use	Per cent.
Medicinal	8
Artificial leather	20
Sulphated oils	25
Lacquers	10
Lubrication	17
Miscellaneous	20

According to the above estimate about thirty per cent. of all the castor oil produced is used for making artificial leather and as a lacquer ingredient. Both of these applications depend upon the superior properties of castor oil as a "plasticising agent." In the manufacture of artificial leather a mixture of 25 per cent. pigment, 25 per cent.

nitrocellulose, and 50 per cent. castor oil is dispersed in a low-boiling solvent and applied to cloth. On evaporation of the solvent a tough leathery coating is deposited on the fabric. This process has been developed to a point where it is said to be difficult to distinguish artificial from genuine leather. It has been found that castor oil, when used in conjunction with nitrocellulose, yields a particularly satisfactory type of film with respect to strength and pliability. This is no doubt partially explained by the unusually high viscosity of castor as compared with other oils. In addition, the presence of the hydroxyl group endows it with a greater degree of miscibility with nitrocellulose than is the case with the other fatty oils, which do not have this structure. Apparently the effectiveness of any compound as a plasticiser depends to a considerable degree upon physical properties such as vapour pressure and miscibility with various resins and solvents. It should be noted that the ability of castor oil to function in this way depends upon its favourable physical properties rather than upon its chemical properties.

Synthetic Drying Oils

Paints contain vegetable oils, such as linseed or tung (china wood) oils, which on exposure to atmospheric oxygen form tough films covering the coated surface. This oxidation process is referred to as "drying," and linseed and tung oils are known as drying oils. They function as such because their fatty acids are highly unsaturated; for example, linseed oil contains a large percentage of the glyceride of linolenic acid, which contains three double bonds. Tung oil is also unsaturated, but it differs from linseed in that its double bonds are conjugated, while those of linseed oil are not. Conjugated double bonds are generally known to be more reactive than an equal number of isolated ones, and it is found in practice that tung oil dries much more rapidly than linseed oil.

Castor oil contains only one double bond and does not have drying properties—that is, it does not react with atmospheric oxygen to form a paint film. A study of the structure of ricinoleic acid showed, however, that removal of the hydroxyl group as water would lead to the formation of a second olefinic linkage. This dehydration may be accomplished easily by heating the oil in the presence of water-splitting catalysts, which are usually weakly acidic materials such as sodium acid sulphate. The product, known as "dehydrated castor oil," contains two double bonds in each fatty acid chain, but not all the pairs appear to be conjugated, since dehydration can and does occur on either side of the carbon holding the hydroxyl group. It is interesting to note that the dehydrated castor oil (some conjugated double bonds) dries to a paint film more rapidly than linseed oil (no conjugated double bonds), but less rapidly than tung oil (mostly conjugated bonds).

Before the introduction of mineral oils during the second half of the last century, almost all lubrication of moving mechanical parts was accomplished by the use of fatty oils. In general it was observed that these gave quite satisfactory performance for the primitive requirements of that time, but in particular it was found that castor oil gave particularly smooth lubrication, especially for engines operating at high speeds for only short periods of time. Early types of racing and aeroplane engines operated smoothly with castor oil for a short interval provided that piston temperatures remained moderate. It was found, however, that continued use of castor oil in the same engine resulted in the breakdown of the fatty oil, with the formation of a sticky resinous mass that rendered the engine almost useless. With the development of higher speed engines, operating at higher temperatures, this difficulty became more urgent, but the improvement of mineral lubricants with their subsequent adoption for high output motors solved the problem while rendering castor oil obsolete. In spite of this general adoption of petroleum

* From an article by E. E. Gilbert in *J. Chem. Education*, 1941, 18, 7, p. 338.

oils castor is still used for engine lubrication. New engines are sometimes "broken in" with castor oil before the change to mineral oil is made, and it has been observed that the quality of "oiliness" possessed to a high degree by castor persists for a remarkable length of time after the shift has been made.

Modern lubrication theory suggests that polar molecules, such as fatty acid esters, are efficient lubricants because their functional groups allow orientation at the surface of the bearing—with the resultant formation of a tenacious film which at the same time reduces friction. The presence of the hydroxyl group makes castor oil even more polar than the usual type of fatty oil, and for this reason it might be expected to possess considerably greater oiliness (power to reduce friction). Since mineral oils consist almost entirely of non-polar hydrocarbon molecules they possess little oiliness compared to fatty oils—and particularly little compared with castor. Mineral oils, however, are stable and do not decompose so objectionably. It might be thought possible to combine mineral oil with castor in such a way as to obtain a stable lubricant with high oiliness. Unfortunately the hydroxyl group—which gives castor oil its enhanced oiliness—also renders it insoluble in mineral oils. Chemists have gone to considerable effort to obtain miscibility, but the results to date have not proved particularly satisfactory. One method of attack has been the use of a mutual solvent for the two types of oil. Another method, said to be in commercial production in Brazil, involves the application of the emulsifying agent triethanolamine. Heating and air blowing also improves its mineral oil solubility, but the resulting blend is said to be rather unsatisfactory, perhaps because during the heating process some of the oiliness-producing hydroxyl groups are removed as water.

The resinous materials formed from castor oil after prolonged use as a lubricant no doubt arise partly as a result of dehydration on the hot metal surfaces of the motor. Air, which is always present in engines, would then cause the dehydrated oil to "dry" as in the case of paint films. The easy dehydration of castor oil can hardly be looked upon as an unmitigated advantage.

Wetting Agents

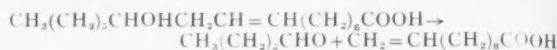
Wetting agents, in general, are made by uniting in one molecule a water-soluble group (such as sulphate) and an oil-soluble group (such as a long paraffin chain). Castor oil is a convenient raw material from which to make such products because water-soluble groupings may be easily introduced by manipulating the hydroxyl group already attached to the paraffin chain of the fatty acid. Castor has long been employed in the manufacture of "turkey-red oil"—a material so called because of its use with red alizarin dye as a wetting and penetrating agent. Turkey-red oil is produced by treating castor oil with strong sulphuric acid, followed by neutralisation with alkali. The product so formed enables dyestuffs to penetrate cloth fibres, and, once having penetrated, to cling more tenaciously. The exact chemical nature of turkey-red oil is still unknown, and its method of manufacture is an art, but something is known of the types of reactions occurring during its formation. The hydroxyl group is probably esterified with the formation of an alkyl sulphuric acid, while another sulphuric acid molecule may add across the olefinic double bond. Solubility in aqueous solvents is determined by the proportion of sulphate groups present, which is in turn decided by the conditions under which the sulphation is conducted. Turkey-red oil is still widely used by dyers, although many of the recently developed special-purpose wetting agents are encroaching upon its field.

Perfumes and Flavours

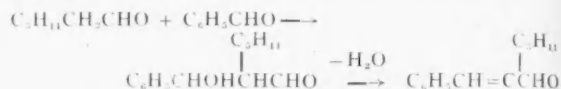
The reactions discussed up to the present have been largely the conventional ones of the hydroxyl group alone, its position in the paraffin chain being secondary. We are now ready to consider a rather unorthodox type of reaction involving both the double bond and the hydroxyl group. The products so formed are of particular interest to the

synthetic chemist since from them a wide variety of valuable compounds may be prepared.

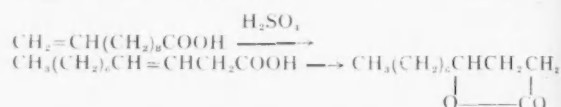
When castor oil is heated *in vacuo*, decomposition of the ricinoleic portion occurs, with the production of heptaldehyde and undecylenic acid as follows:—



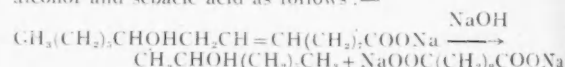
Both these compounds are extensively used as raw materials for the manufacture of perfumes and flavours. On oxidation, heptaldehyde is converted to heptic acid, the ethyl ester of which is widely used as a perfume material. When heptaldehyde reacts with benzaldehyde in the well-known aldol reaction, amyl cinnamic aldehyde is produced as follows:—



The undecylenic portion of the castor oil molecule also finds wide use in the manufacture of flavouring materials. Undecalactone, widely employed as a peach flavour, may be synthesised as follows:—

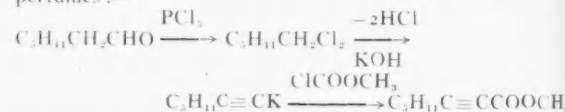


By employing a different type of cleavage reaction, conducted under alkaline conditions, we may obtain capryl alcohol and sebacic acid as follows:—



The alcohol is employed as such and as the butyrate and acetate in perfumes, as is also its oxidation product, methyl hexyl ketone. Ethyl sebacate is used in flavours.

From heptaldehyde may be synthesised methyl heptene carbonate, which is widely used as a constituent of violet perfumes:—



The corresponding octene ester may be made from methyl hexyl ketone.

In the accompanying table are shown a number of additional compounds which may be derived directly or indirectly from castor oil. As time goes on organic chemists are finding many of these compounds increasingly essential in making many useful materials, a number of which are briefly indicated.

CHEMICALS DERIVED FROM CASTOR OIL		
Substance	Method	Use
DIBASIC ACIDS:		
Suberic— $\text{HOOC}(\text{CH}_2)_8\text{COOH}$	Sodium ricinoleate fusion	Synthetic fibres
Azelaic— $\text{HOOC}(\text{CH}_2)_7\text{COOH}$	Ricinoleic oxidation	Synthetic fibres
Sebacic— $\text{HOOC}(\text{CH}_2)_9\text{COOH}$	Ricinoleic oxidation	Synthetic fibres
MONOBASIC ACIDS:		
Heptic— $\text{C}_6\text{H}_{13}\text{COOH}$	Heptaldehyde oxidation	Synthesis
Pelargonic— $\text{C}_8\text{H}_{17}\text{COOH}$	Sodium undecylenate fusion	Synthesis
Undecylenic— $\text{C}_{10}\text{H}_{19}\text{COOH}$	Cracking of castor oil	Synthesis
Undecylenic— $\text{C}_{10}\text{H}_{19}\text{COOH}$	Cracking of castor oil	Synthesis
Hydroxystearic— $\text{C}_{17}\text{H}_{33}\text{OHCOOH}$	Ricinoleic reduction	Synthesis
Heptaldehyde— $\text{C}_6\text{H}_{13}\text{CHO}$	Cracking of castor oil	Perfume synthesis
Capryl alcohol— $\text{C}_8\text{H}_{17}\text{OH}$	Sodium ricinoleate fusion	Perfume synthesis
Isobutyl undecylenamide— $\text{C}_{10}\text{H}_{19}\text{CONHC}_4\text{H}_9$	Heat undecylenic acid and isobutyl amine	Insecticide

Castor oil appears to be in the ascendancy as a raw material for chemical industries. This has been made possible largely by an understanding of the chemical composition of the oil, and by a corresponding knowledge of what types of structure are required for specific uses.

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Metallurgical Section

September 6, 1941

SURFACE TREATMENT OF LIGHT METALS

Chemical and Electrochemical Methods

by FREDERIC NEURATH, Ph.D., and OTTO EINERL, Dr. Eng.

THE rapidly increasing use of light metals in technical fields has made it necessary to find methods for improving the surface of aluminium and magnesium and of their alloys, and for covering them with metallic or non-metallic films. The principal aim is to give increased protection against corrosion, though often there is a question of gaining ornamental effects.

As against copper and its alloys, such as brass and bronze, light metals and their alloys are always more or less covered with an oxide film. Castings have the thickest oxide coating as this is achieved at the highest possible temperature, *i.e.*, the temperature of solidification. But rolled sheets of light metal also possess such an oxide film, which, though thin and invisible, is perfectly solid. It is increased by the heat-treatment to which light metal sheets, wires, etc., are subjected for the purpose of hardening and annealing, with the object of improving their chemical resistance. Alloys of aluminium with magnesium, such as Dural, Y-Alloy and the RR-Alloys (Hiduminium), contain in their oxide film not only aluminium oxide, but also magnesium nitride, which produces the tempering colours characteristic of magnesium-containing alloys.

Three Types of Protective Process

This protective oxide film can be removed by brushing, grinding, polishing or etching, which however makes the comparatively soft alloys more sensitive to exposure to the weather and even to mechanical injury. It was, therefore, necessary to find surface treatments to increase the natural protective oxide film or even to generate it. These surface treatments can be divided into three groups:

(1) Purely chemical methods which for the most part employ aqueous solutions of chromium salts, alkaline solutions being used for aluminium alloys and nitric acid or ammoniacal solutions for magnesium alloys.

(2) Electrolytic oxidation of the surface (anodising) in a bath containing chromic acid or other oxidising additions with an electric current of 30-50 volts at temperatures of 30-40° C.

(3) Galvanising processes for coating the light metals with copper, nickel, chromium, zinc, cadmium, etc. To attain this end the surface must first be made adhesive either by mechanical roughening, by alkaline or acid pickling, or by the recently developed process of preliminary anodic treatment of the aluminium.

Aluminium and its Alloys

Among the purely chemical methods the M.B.V. (Modified Bauer-Vogel process) of the Vereinigte Aluminiumwerke A.G., provides for copper-free aluminium alloys and pure aluminium with a light grey or dark grey protection film which is corrosion-resisting and will not peel off. The articles are dipped at a temperature of 90-100° C. into a solution of M.B.V. mixture, consisting of calcined soda, caustic potash, and sodium chromate.

The processes devised by Pacz (boiling in a solution of sodium fluoride) and by Jirotko (warm nitric solutions of heavy metals salts) can be considered as obsolete.

In the process of G. D. Bengough and J. M. Stuart (*Engineering*, 1926, 122, pp. 274-277) the degreased aluminium is dipped as anode (with graphite or stainless steel as cathode) into an electrolytic bath at 40° C. consist-

ing of a 3 per cent. solution of pure chromic acid. The voltage rises gradually from 40 to 50 volts, with an amperage of 2.8-3.7 amps./sq. ft. (0.3-0.4 amp./dm²). The Günther-Schulze process is similar, but with a starting voltage of 5 volts, rising in 15 min. to 150 volts, with an amperage beginning at 4.6 amp./sq. ft. (0.5 amp./dm²). The Spéfas Process of the Spezialfabrik für Aluminiumspulen (D.R.P. 459,722, 497,943 and 540,734 of 1927/8) aims at the production of oxide-insulated conductor wires without any other insulation.

The Alumilite process, originating in the U.S.A., and the method of Gower O'Brien both employ dilute sulphuric acid (about 10 per cent.) as electrolyte with the addition of glycerine, lead cathodes being used. The Alumilite process allows of further treatment of the oxide films of aluminium alloys for colouring and sealing. The temperature of the bath is 10-30° C., current 10-25 volts, and 5-25 amps./sq. ft. (0.5-3 amp./dm²). This process is used for the production of anodic films on aluminium pistons.

The Eloxal Process, covered by several patents of the Aluminiumwerke Lautz, can be actuated by either direct or alternating current. As electrolyte a bath of oxalic acid is used with the addition of 0.3 per cent. chromic acid or other chemical to speed up the oxidation. The temperature of the bath is 15-40° C., the voltage 30-100. When direct current is used the aluminium is connected with the positive pole. This process is used for castings, sheets, tubes, extrusions, and electrical components.

The Seo Protective Process of Siemens and Halske A.-G. (D.R.P. 635,990 of 1935) uses as cathode aluminium plates previously oxidised in a 0.05 per cent. solution of chromic acid, with an alternating current of 100 volts. The aluminium material to be coated is inserted as anode into a bath of 1.3 per cent. chromic acid containing the above-mentioned aluminium cathodes. The intensity of the current is gradually increased to 40-50 volts and plating coloured dark blue to deep black, or yellowish to brown-yellow is thus achieved. Glass-clear oxide films are achieved by the similar American Akzak Process, the English Brytal Process and the German Schmidt Process.

Slight Polishing Permissible

In general it can be said that the electrical oxidation of aluminium and its alloys should follow the final shaping of the articles under treatment, as working on such articles by filing, grinding and the like would destroy the oxide film; a slight polishing after the oxidation, however, is practicable. Pure aluminium is best for colourless anodisation. Protective films of a high degree of hardness and wear-resistance can be applied to copper-free aluminium alloys low in silicon, which are based on manganese, manganese-magnesium and magnesium-silicon. To this category belong: BA/24, BA/25, BA/24 MS, and BA/60 A of the British Aluminium Co., Ltd.; M.G.7 (DTD 186, 190, 194); Birmabright (DTD 165); BA/23, BA/29 (DTD 300) of the British Aluminium Co., Ltd.; and NA 350 of the Northern Aluminium Co., Ltd.

With alloys containing copper, copper-nickel, copper-magnesium, copper-zinc, or silicon and silicon-magnesium as additions to aluminium, the obtainable films are generally softer, but here also the chemical resistance is improved. To this category belong: 3L5, L8, 4L11, DTD

424 and 428, RR 50, 53, 53 C (RR Alloys of High Duty Alloys, Ltd.) Y Alloy, Ceralumin, Silicon-Aluminium Alloys, Birmasil, NA 161, NA 24S, Duralumin G, Hiduminium 72, etc.

With the galvanising processes, degreasing of the aluminium parts has to be done with the customary care. Electrolytic degreasing baths are just as efficient (especially for polished surfaces) as the various alkaline lyes, with subsequent processing with dilute nitric acid or hydrofluoric acid. The alkaline liquor, usually sodium zincate solution with excess of alkali, into which the degreased aluminium parts are dipped for a few seconds only, has a temperature of 30-40° C. Acid pickling baths of various compositions are also employed; these contain hydrochloric acid solutions of iron, nickel or manganese chloride. They are most suitable for aluminium alloys if they have a low content of the metallic salt, while for pure aluminium (over 99 per cent.) only acid solutions with a high metal salt content are advisable, e.g. (20 per cent. NiCl_2 in a 20 per cent. solution of HCl).

Preliminary treatment of aluminium to produce a suitable surface for the coating is carried out by the following methods: (1) The Elytal Process of Siemens and Halske A.-G. (D.R.P.P. 610,210, 631,371, and 632,032 of 1933/34). The film obtained through the anodic oxidation is partly etched off so that a film skeleton remains serving to bind the plating metal to the aluminium. (2) The Travers Process of W. J. Travers, Krome Alume Inc., U.S.A., provides for an alternating current bath with a 2½ per cent. solution of oxalic acid and a 50-volt current. After thorough washing, the material is treated for some hours with a 5-per-cent. sodium cyanide solution.

Nickel Plating

It was found that nickel coatings adhere best to aluminium when using a bath of 12 per cent. nickel sulphate, 1 per cent. sal ammoniac, 6 per cent. magnesium sulphate, and 1 per cent. boric acid, at a temperature of 32-35° C. and a current density of 15 amp./sq. ft. (1.6 amp./dm²). As nickel coatings easily become porous it is better to produce first a thin nickel film, then a thin copper film and lastly the final nickel layer. The nickel film can then be used also as a foundation for the plating with chromium.

In nickel plating operations generally a pure nickel anode is used while the object to be plated, after thorough cleaning to remove dirt, grease, and oxide coatings, acts as the cathode. A slightly acid solution of nickel ammonium sulphate is commonly used as electrolyte. Various compositions are given in the following table taken from Circular 100, U.S. Bureau of Standards. In operating, the current usually starts at 12-14 amp./sq. ft. and is then diminished to 2-4 amp., to assure a smooth solid deposit. Agitating the electrolyte speeds up the operation; it gives a more uniform deposit and increases the efficiency. The voltage varies from 1.4 to 4 volts, according to the composition and character of the material to be plated. A smoother and more satisfactory deposit is achieved if the articles to be plated are not only cleaned but polished.

SOLUTIONS USED IN NICKEL PLATING.

	g./l.	oz./gal.
1. Nickel electrotyping:		
Nickel ammonium sulphate	45	6
Nickel sulphate	15	2
Sodium chloride	7.5	1
2. Nickel Plating—Double-salt Solution:		
Nickel ammonium sulphate	75	10
Ammonium chloride	22.5	3
Boric acid	15	2
3. Nickel Plating—Single-salt Solution:		
Nickel sulphate	120	16
Ammonium chloride	22.5	3
Boric acid	15	2
4. Nickel Plating—Fluoride Solution:		
Nickel sulphate	280	37
Sodium fluoride	8	1
Boric acid	30	4
5. Nickel Plating (Watts) for high current density or in hot solution:		
Nickel sulphate	240	32

Nickel chloride	15	2
Boric acid	30	4
6. Nickel Plating on Zinc (Hammond):		
Nickel sulphate	240	32
Nickel chloride	15	2
Boric acid	30	4
Sodium citrate	175	23

Magnesium and its Alloys

Purely chemical methods include the chromate pickling method for Elektron alloys, using a nitric acid solution of bichromates with 15 per cent. bichromate of potassium or sodium, 20 per cent. concentrated nitric acid and 65 per cent. water; and the alkaline chromate process (B.P. 331,853 and 353,415), which applies a solution in boiling water of bichromate of potassium or ammonium with the addition of potassium-aluminium sulphate or ammonium sulphate, made alkaline by caustic soda or ammonia (0.5 cent.).

The chief electrochemical process, the Elomag Process of the Langbein-Pfauhauser Werke, allows for the electrolytic oxidation of the surface either of pure magnesium or of Elektron alloys. The resulting film of magnesium oxide is non-conducting; it is absorbent and is not as hard as the Eloxal film. Galvanising methods have also been employed for coating magnesium alloys with heavy metals, but so far with not very satisfactory results.

Much interest has recently been taken in chromium plating, because of the fact that when a chromium film has been properly applied it is very hard, and resistant to scratching. It does not tarnish under ordinary conditions, thus making polishing unnecessary. A good chromium film needs only ordinary cleansing from dirt to keep it bright. Considerable difficulty has been encountered in plating irregular objects, and secrecy is generally observed regarding methods to overcome these difficulties. The results of an investigation of chromium plating factors have been published by Hering and Barrows (U.S. Bureau of Standards, Technological Paper, No. 346).

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A complete phase diagram for the system Fe-Al-Si has been constructed by Takeda and Mutuzaki in *Tetsu to Hagane*. By means of structural X-ray, magnetic, and dilatometric investigations they have demonstrated the existence of the ternary compounds $\text{Fe}_3\text{Al}_3\text{Si}_3$, $\text{Fe}_6\text{Al}_{12}\text{Si}_3$, $\text{Fe}_5\text{Al}_9\text{Si}_3$, FeAl_3Si_2 , $\text{Fe}_6\text{Al}_{12}\text{Si}_5$ and FeAl_3Si .

Preparation of Pure Aluminium

Electrodeposition from Chloride Melts

MANY patents deal with electrolytic preparation of aluminium containing less than 0.05 per cent. of impurities. Most of them, following Hoops (1900) and Betts (1905), specify a fluoride (chiefly cryolite) as the electrolyte to be used. Plotnikov, Kirichenko, and Fortunatov (*Zapiski of the Chem. Inst. Ukrain. Acad. Sci.*, 1940, 7, 193) found that chloride melts were in some respects superior to fluorides. A melt containing 38 per cent. AlCl_3 and 62 per cent. NaCl was chiefly used, the melting temperature of this mixture being 152°C . The electrolysis was carried out mainly in a porcelain beaker of 300 c.c. provided with a lid to prevent evaporation of AlCl_3 . On the bottom of the beaker stood a corundum crucible. The anode was a molten aluminium alloy surrounding the crucible, and the cathode was a graphite rod suspended over the crucible. The beaker was filled with AlCl_3 and NaCl . The electrodeposit of aluminium fell into the crucible and was analysed after cooling.

When the anode was an Al-Cu alloy containing 15-37 per cent. copper, no copper could be detected in the aluminium deposit. The conditions were: $800-850^\circ\text{C}$., 1 amp. per sq. cm., 33 amp.-hours. No iron was transported to the cathode when the alloy Al 90, Fe 4 was employed; the temperature was $800-850^\circ\text{C}$., and the current density varied between 0.4 and 1 amp. per sq. cm. If the anode contained 8 per cent. of iron, the aluminium deposit contained 0.003 per cent. of iron when the current density was 0.7 amp./sq. cm., and 0.009 per cent. Fe at 1 amp./sq. cm.

Less favourable results were observed when using aluminium-zinc alloys. When the percentage of zinc was 8, 15, or 27, the deposit contained 0.02, 0.52, and 0.99 per cent. Zn respectively. The electrolytic elimination of manganese was not more successful. With 2.5 per cent. manganese in the anodic alloy, the cathodic deposit contained 0.03-0.07 per cent. Mn, when the current density was 0.5-0.7 amp. per sq. cm. Starting from an alloy with 5 per cent. manganese a deposit with 1.45 per cent. Mn was produced at 1 amp./sq. cm., temperature $800-840^\circ$.

In all these instances the deposit was adulterated with silicon which was present in amounts up to 0.75 per cent. Its source was the porcelain of the beaker which was visibly corroded by the molten alloys. Pure aluminium was then prepared by substituting a corundum bath for the porcelain beaker and taking care to prevent any silicates coming in contact with the metal melt. Under these conditions spectroscopically pure aluminium could be obtained. This was also possible when commercial aluminium was employed as the anode. One sample used for anode had, for instance, 0.27 per cent. Si and 0.14 per cent. Fe, and another 0.72 per cent. Si and 0.15 per cent. Fe. They gave aluminium of spectroscopical purity, the current density being 0.5 amp./sq. cm., temperature $800-875^\circ\text{C}$.

Ferrous Metals in Canada

Steady Output Maintained

PRODUCTION of pig iron in Canada totalled 103,326 long tons in April compared with 102,038 in March and 84,210 in April, 1940, according to official statistics quoted by *Foreign Commerce Weekly*. The April total included 84,033 tons of basic iron, 11,277 of foundry iron, and 8016 of malleable iron. In the first four months of 1941, 711,040 long tons of ore, 188,807 short tons of limestone, and 398,598 short tons of coke were charged to iron blast furnaces in Canada to make 399,614 tons of pig iron. Blast furnaces operated at 92.8 per cent. capacity during April, one 300-ton furnace at Sault Ste. Marie being inactive.

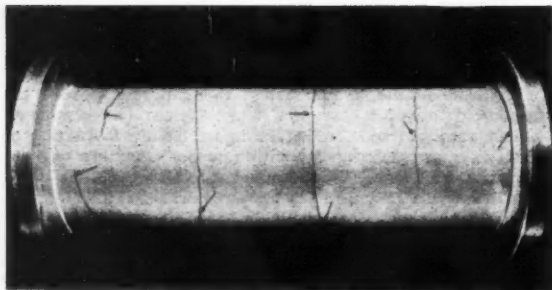
Aggregate output of ferro-alloys during April was 16,161 tons, compared with 15,201 in March, and 13,989 in April a year ago. The April, 1941 total included eight main grades, listed according to tonnage as follows: ferrosilicon, spiegeleisen, ferrochrome, ferromanganese, silicomanganese, calcium-silicon, ferrophosphorus, and calcium-manganese-silicon.

Research in Quenching Stresses

Tests on Aluminium Alloys

WITH the introduction of heat-treatable aluminium alloys the phenomenon of the quenching stresses that occur in them becomes important. Dr. A. von Zeerleder, of Neuhausen, describes in the *Journal of the Institute of Metals* (1941, 67, 895, pp. 87-99) work he undertook on such stresses in the research department of the S.A. pour l'Industrie de l'Aluminium, Chippis, Switzerland. His work related particularly to the alloy Avional D, as representative of the Duralumin class most used. Tests were carried out with extruded bars of 50 mm. diameter. These had been made from billets of 200 mm. diameter cast in ordinary iron moulds. The alloy was composed percentually of copper 4, silicon 0.2, magnesium 0.6, manganese 0.5, iron 0.2, and the remainder aluminium.

Heat stresses occur to the greatest extent when heated materials are quenched. By the rapid cooling of the material its thermal expansion is suddenly reversed. During the cooling of a round billet by quenching, the outer layer cools more quickly than the core and, because of the volume contraction, shrinks on the core, which has not yet begun to contract; i.e. the outer layer is submitted either to elastic strain or to over-straining. As a result of the subsequent cooling of the core, a state of equilibrium is next set up between the stretched outer zone and the compressed core. With further cooling of the core a reversal of the stresses takes place, as the contraction of the



Cracks appearing in an aluminium billet during turning, owing to heat stresses

core continues, and the core is thereby subjected to tension. The outer layer will therefore experience compressive stresses.

The magnitude of the cooling stresses depends essentially on the nature of the cooling. Tests carried out on steel shafts of 35 mm. diameter, showed that cooling of the test-pieces from 600° or 800° C. in air, or even quenching in oil, produces only small internal stresses. On the other hand, quenching in cold water causes considerable cooling stresses. It may, therefore, be concluded that the magnitude of the internal stresses largely depends on the temperature, boiling point, specific heat, thermal conductivity, surface tension, and viscosity of the quenching medium. In addition, the coefficient of expansion, temperature, thermal conductivity, and specific heat of the quenched material have some effect. According to radiographic investigations carried out by Wassermann in 1935, the size of the test-pieces up to a certain thickness is also a factor. Wassermann found that test-pieces of pure aluminium of 1 mm. diameter are almost free from strains. With increasing diameter the stresses rise quickly and reach a maximum of 5.6 kg./mm.² at about 7 mm. diameter. The present investigation shows that the magnitude of the internal stresses does not increase with greater diameters; quenching tests with 200 mm. round billets and 50 mm. round bars gave rise to strains of almost the same magnitude. These cooling stresses often cause distortion or warping, and sometimes even tearing, during the work-

ing of solution heat-treated materials, whereby the pieces are ruined.

As already stated, compressive strains appear in the outer layers and tensile strains in the core during cooling. It is, therefore, possible to release and eliminate the strains by suitable mechanical working, such as stretching, or upsetting of the quenched pieces. Moreover, the stresses can be partly or wholly removed by a further heat-treatment (tempering); though this may cause undesirable precipitation in aluminium alloys, especially in the case of Avional alloys (copper-magnesium-aluminium) in which precipitation impairs, for example, the electrode potential and the corrosion-resistance. There remains, therefore, the method of removing the internal stresses by mechanical working. This method consists in subjecting the piece to a small deformation of another kind. With drawn materials this procedure can be combined with the straightening. For this operation uncoiling machines and inclined-roll straightening machines are used, through which the bars pass in rotary motion and become thereby somewhat reduced in diameter. In this way the compressive stresses in the outer layer are reduced to an extent dependent on the degree of uncoiling, or are even transformed into tensile stresses. It is also possible to reduce the internal strains by bending or hammering. According to D.R.P. 653,981 internal stresses in shaped wrought or cast pieces may be eliminated by subjecting the pieces, over their whole surface, by compression in a liquid, to a pressure which has previously been determined on the basis of the Brinell hardness and proof stress of the material concerned.

The changes in length caused by turning off the outer layer in stages were determined with a gauge made especially for this purpose. The figures obtained at the prevailing room temperature were reduced to the values at 20° C. by means of the coefficient of expansion, determined with the same measuring device, and by taking a modulus of elasticity of 7500 kg./mm.² as a basis for the calculations.

Quenching Medium Examined

A study was made of the influence of cooling before quenching, and of the temperature and the nature of the quenching medium, as well as of the influence of cold working by stretching or upsetting before or after the ageing at 20° C. The stresses diminish somewhat with increasing time of cooling prior to quenching. Notable differences of strains appear with variation of the temperature and character of the quenching medium; the greatest strains appear at the lowest temperature of 20° C. At 50°-60° C. the strains have already diminished markedly, while at 100° C. they have disappeared almost entirely. After quenching in oil only small strains appear, which are practically independent of the temperature of the oil.

In the changes of strain caused by small amounts of cold working (stretching or upsetting) before or after ageing, it appears that an important reduction takes place as a consequence of 2 per cent. cold stretching before or after ageing at room temperature. In the core the stresses are even reversed. A similar effect is caused by 1 per cent. upsetting after the ageing; in this case also a definite reversal of the strains in the outer layer occurs.

SHEET METAL INDUSTRIES ASSOCIATION

A meeting was held in the Engineers' Club, Manchester, on September 4, to form a Sheet Metal Industries' Association to deal with the trade and technical problems of a branch of industry that has been greatly expanded to meet war demands. Manchester has been chosen as the starting point of the movement, and about 500 invitations to manufacturers and technicians engaged in sheet-metal working have been issued. Other meetings are to be held in London, Birmingham, Sheffield, and Scotland.

General News

The Mines Department has sent a letter to Government departments drawing their attention to the urgent need for the strictest economy in the use of all fuels whether for heating or lighting.

The British Standards Institution has published BS/ARF 56, 57, and 58, new standard specifications dealing with the rot-proofing of yarn and cordage, sandbags, and canvas (4d. each, post free).

The translation service of the Iron and Steel Institute announces that further translations have been put in hand and some are now available, since their last circular on this subject was published on June 28.

Among new members of the Manchester Chamber of Commerce, elected at a meeting held on August 11, are included Messrs. Kurt Gornitzky, manufacturing chemists of 13 Merry Bower Road, Broughton Park, Manchester, 7.

After a short debate at the 73rd annual Trades' Union Congress at Edinburgh last Monday, a motion to readmit the Chemical Workers' Union to affiliation—a matter which had been discussed on several previous occasions—was defeated by 2,404,000 votes to 2,333,600.

A mission representing the management and the labour sides of British industry is to visit the United States, at the invitation of the Council of the Office of Production Management, and make a tour of defence industries. It will arrive in the United States during September.

The Board of Trade has made an Order amending the War Damage (Business Scheme) Order, 1941, to permit insurance under the Business Scheme on a voluntary basis of containers for the supply of goods. The containers, owned by the supplier, but not in his possession, must not exceed a value of £5 each.

The New York Oil, Paint and Drug Reporter reports that the Federal Government is preparing to send Great Britain a "substantial quantity" of rosin under the terms of the Lease-Lend Act. The rosin is to come from Government stocks now held by the Commodity Credit Corporation. The journal also states that Britain has made an informal request for 90,000 barrels of turpentine, 17,000 tons of liquid rosin, and 3000 tons of pine tar, as well as approximately 250,000 barrels of rosin.

Factories in which toilet preparations are used for protection of workers against dermatitis have been limited in the quantities they can get by the Limitation of Supplies, No. 11 Order. If they are unable to get enough for their needs, and provided that one of H.M. Inspectors of Factories certifies that there is a risk of dermatitis in the nature of the factory work, the Board of Trade will issue a special licence to the supplier of the preparation. This will permit quantities to be obtained by the factory beyond the supplier's quota.

"Post-War Questions," Nos. 5 and 6, are the latest pamphlets to be published by the Individualist Bookshop, at 6d. each. The former, by Dr. W. R. Inge, is entitled "Possible Recovery," and contains an able re-statement of the author's well-known views. In No. 6 Sir Ernest Benn tilts at "The B.B.C. Monopoly," a subject which, as a senior Fellow of the Institute of Journalists, he is well qualified to handle. Few will quarrel with his objection to putting "40 million pairs of ears into the slavery of a monopoly."

Imperial Chemical Industries, Ltd., propose to publish a quarterly journal of science, and hope to issue the first number during the autumn. The journal will be translated into at least three foreign languages and will have a world-wide circulation. Although published by I.C.I., the journal will in no sense be an advertising medium. Many distinguished scientists have expressed their willingness to contribute, and the chief article of the inaugural number will be by the Astronomer Royal, Dr. H. Spencer Jones.

Foreign News

A promising deposit of chrysotile asbestos has been discovered about 135 miles to the north-west of Madras.

From Week to Week

The re-export from Uruguay of base metals, chemical products, dyes, and many other articles has been prohibited by a decree.

The staff of the National Research Laboratories at Ottawa has been almost doubled since the war began. Figures up to the end of March show that the staff has grown to 574 compared with 308 in July, 1939.

The synthetic organic chemical industry in the United States is reported to spend annually in research the equivalent of over 4.5 per cent. of its total dollar sales, compared with 0.2 per cent. so expended by American industry as a whole.

A new Brazilian factory for producing anhydrous alcohol is expected to begin operations shortly in the municipality of Ponta Nova, Minas Geraes, with an initial monthly output of 90,000 litres.

The American Chemical Society is holding its 102nd meeting at Atlantic City on September 8-12. The Philadelphia Section is in charge of the meeting, and Dr. Seymour W. Ferris, chief chemist of the Atlantic Refining Co., has been appointed chairman of the executive committee.

Excellent results are reported to have been obtained in Italy during 1940 in producing zinc free from all impurities, a field not yet thoroughly explored there. Research in the production of zinc alloys is to be continued; German technicians are said to have been particularly attracted to this work.

Dr. Bergius, a German Nobel prize-winner in chemistry, is said to have invented an artificial stomach capable of predigesting wood and preparing it for human consumption. He claims that hydrocarbon products forming the basis of compounds similar to white-of-egg can be obtained by this means.

Several small mercury deposits have been opened in the Chihuahua district of Mexico during the past few months, as a result of the intensive search for the rarer metals in that area. Production is said to have increased from 5 to approximately 60 flasks (4560 lb.) monthly. Nearly all the mercury produced in the district is sold to Japan.

A compound which protects shoes from the effects of mustard gas has been developed by the U.S. Chemical Warfare Service, and is now in production. It will be issued to troops, when required, in the form of paste packed in tins resembling boot-polish tins. Its composition remains a military secret. So far, five manufacturers have been commissioned to prepare the material.

Forthcoming Events

A meeting of the Refractory Materials Section of the British Ceramic Society will be held at the North Staffordshire Technical College, Stoke-on-Trent, on September 8, at 11.30 a.m., under the chairmanship of Mr. J. W. Fagan, when three papers entitled "The Effect of Increasing Heat Treatment on the Properties of a Diatomaceous Insulating Brick," "Shetland Chromite as a Refractory Material," and "Some Requirements of Casting Pit Refractories" will be read. All interested are cordially invited to attend. The annual meeting of the Society will follow at 6 p.m.

The Manchester Section of the Oil & Colour Chemists' Association will meet at the Engineers' Club, Albert Square, Manchester, on September 10, at 2 p.m., when a lecture entitled "Petroleum Products in the Paint Industry," will be delivered by H. D. Axe, M.A.

A meeting of the London Section of the British Association of Chemists will be held at the Café Royal, Regent Street, W.1, on September 13 at 2.30 p.m., when Mr. T. McLachlan, D.C.M., A.C.G.F., F.I.C., will open a discussion on "The Training of the Chemist." Mr. W. C. Peck, M.Sc., A.I.C., M.I.Chem.E., will be in the chair. The meeting is open to members of kindred societies.

The London Section of the Oil & Colour Chemists' Association is holding a lunch-time social, beginning at 1 p.m., on September 20, at Oddenino's Restaurant, Regent Street, London, W.

Personal Notes

MR. R. H. ARCHER has been appointed managing director of Mander Bros., Ltd., varnish manufacturers, Wolverhampton, after serving for eight years as general manager.

MR. WILLIAM HENRY STEVENS, an executive of the Monsanto Chemical Co., Ltd., of London, is touring American rubber plants to study methods of fabrication, notably of self-sealing fuel tanks and oilproof aeroplane parts. Mr. Stevens is to spend several weeks at the Trenton plant of the Thiskol Corporation.

DR. ROLAND S. YOUNG, formerly of the International Nickel Co. of Canada, Ltd., has taken up an appointment at Nkana, Northern Rhodesia, as chief chemist to the Rhokana Corporation, Ltd., Nchanga Consolidated Copper Mines, Ltd., and Rhodesia Broken Hill Development Co., Ltd.

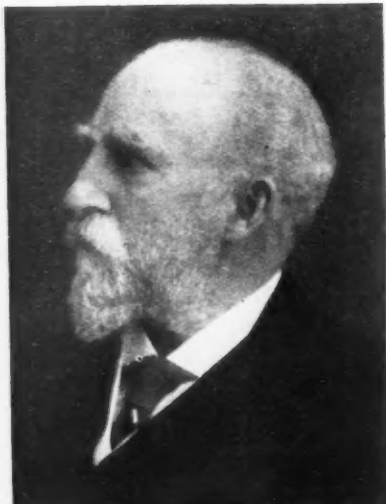
DR. G. E. F. LUNDELL, head of the chemistry division, National Bureau of Standards, Washington, D.C., has been elected president of the A.S.T.M. for the ensuing year. He served as vice-president of the organisation from 1939 to 1941 and has been chief chemist of the Bureau since 1937.

DR. J. ENRIQUE ZANETTI, D.S.O., Professor of Chemistry at Columbia University, New York, has again been called to the colours to serve in the Chemical Warfare Service of the U.S. Army, with the rank of colonel. Dr. Zanetti saw active service in the last war with the A.E.F., reaching the rank of lieutenant-colonel in the Chemical Warfare Service. He received American, French, and Italian, as well as British decorations for his distinguished services.

MR. MORRIS WILSON, president and managing director of the Royal Bank of Canada, and at present serving as deputy chairman of the British Supply Council in North America, has been appointed chairman of the Council in succession to the late Mr. Arthur Purvis. Mr. E. P. TAYLOR has been appointed vice-chairman and president of the Council. Both men have declined to receive any remuneration.

Obituary

MR. WILLIAM MACNAB, C.B.E., F.I.C., M.Inst.Chem.E., consulting chemist, died at Cookham Dean, Berks, on September 2 in his 84th year. A native of Greenock, Mr. MacNab was educated at the Academy of that burgh and at



Mr. William MacNab

Edinburgh Institution and Glasgow University. Early in his career he specialised in sugar chemistry, holding positions at Magdeburg (1878), and in London, as chief chemist of the Clyde Wharf Sugar Refinery. Later, he was attracted to chemical engineering during his connection with

the Water Softening Company. In 1888 he entered into a consulting partnership with Napier Hake, and then began his long association with the chemistry of explosives. Widely travelled, he served as honorary secretary of the 7th International Congress of Applied Chemistry in 1909, and was a member of Lord Moulton's famous Committee on Explosives in 1914. For his work as technical adviser to the Ministry of Munitions (Explosives Supply Dept.), during the last war he was created C.B.E. in 1920. In 1915-16 he was a member of the council of the Chemical Society; he was an original member of the Society of Chemical Industry, and served many years on its council and as vice-president, also on the committee of the Chemical Engineering Group. In 1887 he was elected Fellow of the Institute of Chemistry, of which he became vice-president in 1921-24. In 1934 he was elected 6th President of the Institution of Chemical Engineers, a body of which he was one of the founders. With MacNab's death the chemical industry loses one of the leading authorities on explosives chemistry among the older generation. He was, however, far from being a one-subject man, and his general and special knowledge of mining and metallurgy was broadened by his travels which took him over half the world.

MR. PERCY HEDLEY, who died on August 27 at Carham-on-Tweed, Northumberland, aged 76, had been chairman of Wailes Dove Bitumastic, Ltd., since 1937. He had served the company for some 30 years, and married the daughter of the late E. J. Dove, one of the firm's founders. He was elected to the board of directors 20 years ago and succeeded the late Bruce Harman in the chairmanship.

MR. E. BERNARD SMITH, former president of the Newfoundland Power and Paper Co., Ltd., who died at Montreal on August 4, aged 68, was a native of Petersham, Surrey, and earned a degree in chemical engineering in England. He went to Canada in 1912, and for 25 years was vice-president and general manager of the Dominion Tar and Chemical Co. From 1929 to 1939 he was an executive of the British American Oil Company.

New Control Orders

Export of Vitamins, Glass Tubing and Certain Chemicals

THE Board of Trade has made the Export of Goods (Control) (No. 29) Order, 1941, which will come into force on September 11 (S.R. & O. 1941, No. 1247, price 1d.). Under its terms licences will be required to export, to all destinations: glue and size; glue stock and pieces suitable for making glue; leaf and foil of non-ferrous metals and alloys thereof, in all forms; antimony sulphides; nicotinic acid; potassium ferricyanide and ferrocyanide; sodium ferrocyanide; ascorbic acid (vitamin C) and its preparations; insulin and insulin protamine with zinc.

Licences will be required to export fluorspar to certain specified destinations.

Licences will be required to export vitamin A, vitamin B₁, vitamin C (ascorbic acid) and vitamin D, including concentrations, solutions and preparations thereof; and casein and plastic materials derived therefrom, whether plain or pigmented, in the form of powder, granules, sheets, strips, blocks, rods or tubes.

The prohibition in respect of glass phials (vials), bottles and tubular containers made from tubing does not include test-tubes and, in respect of glass tubing, is limited to tubing of a wall thickness less than 2 mm.

The use in nitrocellulose lacquers of Damasol, a new purified damar sold as a 70 per cent. transparent solution, is set forth in a ten-page booklet published by MESSRS. SCOTT BADER AND CO., LTD., Wollaston, Northants. The acid value of Damasol is between 20 and 25 and the concentration shows that 70 per cent. is sold and 30 per cent. volatile solvents. It is miscible in all proportions with any nitrocellulose solution.

A CHEMIST'S BOOKSHELF

MERCERISING. By J. T. Marsh, M.Sc., F.I.C., F.T.I. London: Chapman and Hall. Pp. 458. 35s.

The term "mercerisation" refers essentially to the treatment of cotton by caustic soda, of a certain strength and under specified conditions of tension, in order to effect certain physical and chemical modifications, which result in enhancing the appearance and strength of the yarn or cloth on which the operation is performed. It has, however, the more general, but no less important significance as the process of treating cellulose (wood pulp, linters, cotton, etc.) with caustic soda of a certain strength, and is so called in the rayon industry to include the operation of converting cellulose into "soda cellulose," prior to the treatment with carbon disulphide, which gives the cellulose xanthate, basis of "viscose." The main point to remember about "mercerising" is that the investigation of the changes brought about by the operation has formed the foundation of some of the most important work done on cellulose structure in recent years. Interest in this aspect considerably outweighs that involved in the operation of mercerising *per se*.

Mr. Marsh, whose qualifications for writing the much needed standard book on mercerising are guaranteed both by his earlier performance with Dr. F. C. Wood on cellulose chemistry, and by his part in some of the most far-reaching textile developments of to-day, tackles his subject in the only logical way, *i.e.*, by a reprint of Mercer's patent and an account of Mercer, Lowe, and others concerned with the early history of mercerising.

This historical section is on the whole excellent, and introduces interesting facts and episodes which, to the reviewer at least, were new. On consideration, however, one cannot help thinking that too much credit has been given to Lowe who, after all, had not the capacity to commercialise his own discoveries and on whom reward was really thrust. Too little credit is given, on the other hand, to the work of the firm of Thomas and Prevost. Our own reading of the history of those early days suggests that the situation might have been somewhat as follows:—In 1805 Thomas and Prevost were working with some half-silk fabrics in which they sought to avoid the shrinkage which had previously been desirable as forming the basis of what are nowadays known as "caustic crêpe," and were using wooden frames on which the goods were stretched for drying after impregnation with caustic. Thereupon they observed that the reverse of the fabric (cotton) acquired an unusual lustre. They then extended their investigations to cotton yarns and instructed Wansleben Gebr. in Crefeld to build a suitable stretching machine. They incorporated this discovery in two patents, D.R.P. 85,504 and 97,604 of 1805. The first of these mentioned the stretching merely to avoid shrinkage; the additional patent speaks as well of the increased strength and the silky lustre of cotton treated with caustic soda under tension. The process caused a great sensation and objections followed. In 1808 the first patent was annulled by the patent office decision that, in the three main particulars it resembled Mercer's patent of 1850 too closely. The second Thomas and Prevost patent, however, remained valid for some time, until the long forgotten patent of the Manchester chemist Lowe (B.P. 4452 of 1890) was dug up. This covered the prevention of shrinkage by tension during treatment with caustic liquor, but, as secondary phenomena connected with the process, mentioned increased strength, moisture absorption, density and glossy appearance, together with deeper dyeing.

The scientific approach to the subject of mercerisation extends to a series of questions. The equilibrium of the system aqueous liquor/cotton is characterised chemically by determining the binding of water and alkali to the cotton and by observing the radiographic changes which the cotton thereby undergoes. Observations of the changes in fibre dimensions serve to characterise it physically. Comparison of the properties of native and mercerised cotton, *e.g.*, in regard to their sorption capacity towards dyestuffs and water, forms another important object of these investigations. In regard to the most important technical effect

of mercerisation, lustre, there are unfortunately few investigations in a form enabling them to assist substantially in the interpretation of the phenomenon.

Mr. Marsh follows up his account of mercerising on these lines. His work is extremely comprehensive and well-documented, a single objection being that he is scarcely selective enough, many investigations being mentioned which hardly deserve the consideration given. It was good to see the account given of Klughardt's "lustre numbers" γ and G . The literary quality of the book is also considerably higher than that of the author's previous work in collaboration with Dr. Wood, and lack of clarity in exposition is nowhere apparent, though it may be as well to mention here that one or two errors have crept in. Altogether Mr. Marsh has done extremely well by his subject and has added a valuable contribution to the by no means abundant literature of the textile industry.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Company Winding-up

CADMIUM PLATING CO., LTD. (C.W.U., 6/9/41). Winding-up order, August 14.

Company News

The United Indigo and Chemical Co., Ltd., have declared a dividend of 6½ per cent. for the current year (same).

The British Oxygen Co., Ltd., is maintaining its interim dividend of 7 per cent. on the ordinary capital. Last year's distribution was followed by a final payment of 8 per cent.

Thorncliffe Coal Distillation, Ltd., have declared a final dividend for the year ended June 30 of 25 per cent., again making 50 per cent. for the year.

The directors of the **Blythe Colour Works, Ltd.**, have declared a half-yearly dividend of 6 per cent., on preference shares, payable September 30.

William Neill and Son (St. Helens), Ltd., have announced a second interim dividend of 7 5-24 per cent., making 12 5-24 per cent. for year ended March 31.

Greeff-Chemicals Holdings have announced a profit of £19,343 (£25,826), and as already stated in these columns, have declared a final dividend on the ordinary shares of 7 per cent., making 10 per cent. (12½ per cent.).

The Staveley Coal and Iron Co., Ltd., have declared a final dividend of 4 per cent., making 6½ per cent. for the year, free of tax (8 per cent.), and announce a net profit of £294,429 (£417,571).

The directors of the **United Turkey Red Co., Ltd.**, announce that no dividend will be paid on the 4 per cent. first or 5½ per cent. second cumulative preference shares, for the half-year ended June 30. The dividend on the first preference shares is in arrears from January, 1938, and that on the second preference shares from January, 1934.

New Companies Registered

Merrylee Chemicals, Ltd. (21,825).—Private company. Capital, £100 in £1 shares. Chemical manufacturers, metallurgists, dry-salters, etc. Subscribers: Mrs. J. Phillips; Elizabeth A. Stewart. Registered office: 213 West Campbell Street, Glasgow. Registered in Edinburgh.

Recoil, Ltd. (368,880).—Private company. Capital, £1000 in 1000 shares of £1 each. Oil extractors, degreasers, distillers, producers and importers of and dealers in oils, lubricants, greases, tallow, benzol, tar, bitumen, oil and other fuels, etc. Subscribers: M. B. Henderson; A. R. Sneddon. Registered office: 335-337 Hedon Street, Hull.

Collective Chemical Company, Ltd. (368,995).—Private company. Capital, £100 in 50 preference and 40 ordinary shares of £1 each and 400 deferred shares of 6d. each. To enter into agreements with Dr. Ladislav Zakarias, the founder of the system of collective chemistry, for the development, realisation and marketing of his invention, processes and products, etc., manufacturers of and dealers in chemical products, preparations, compositions, etc. Subscribers: Mrs. Margaret H. Wallace; Hugh McKay F. Hill. Registered office: Lloyd's Bank Buildings, Small Street, Bristol.

Weekly Prices of British Chemical Products

VALUES continue on a firm basis in all sections of the general chemicals market and there are no outstanding price alterations to record. A moderate volume of new inquiry is in circulation both for home and export and there appears to be no further deterioration in the general supply position. In most cases contract deliveries are well up to schedule. Permanganate of potash is an active market with the technical quality receiving more attention on the recently reduced scale of quotations. Elsewhere in this section bichromate of potash and caustic potash are being allocated for approved requirements whilst offers of odd lots of yellow prussiate of potash are finding a ready market. The position of most of the soda products remains unaltered, a strong demand being in evidence for hyposulphite, chlorate, and yellow prussiate. In the acid section oxalic acid continues in short supply whilst there is a keen demand for all available offers of citric and tartaric acids. Acetic acid is in steady request. Amongst the coal tar products cresylic acid and carbolic acid crystals are both active items and there is a brisk demand for xylol, toluol, and solvent and heavy naphtha.

MANCHESTER.—In spite of some contraction here and there in the demand for textile chemicals on the Manchester market the movement of most classes of materials in the principal

industrial sections is maintained at a satisfactory level. Contract specifications are circulating fairly freely, whilst a moderate amount of fresh business has been put through during the past week at a firm range of prices. There has been no contraction in the volume of inquiry on the tar products market, and in most classes, particularly cresylic acid, supplies are difficult to secure for early delivery except against contracts. Under the circumstances, values are mostly extremely strong.

GLASGOW.—There is again no change in the Scottish heavy chemical trade during the past week. Business maintains its steady transactions for spot delivery. Export inquiries are rather limited. Prices remain firm.

Price Changes

Rises: Ammonium sulphate, carbolic acid, cresylic acid, chrometan, naphtha, potassium permanganate, pyridine, sodium metasilicate, sulphur.

Falls: Naphthalene.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s.; 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £10 ton, d/d, nominal.

Aluminium Sulphate.—£10 5s. per ton d/d.

Ammonia Anhydrous.—1s. 7d. to 2s. 2d. per lb.

Ammonium Carbonate.—£32 to £39 per ton d/d in 5 cwt. casks.

Ammonium Chloride.—Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. See also Sal ammoniac.

Antimony Oxide.—£68 per ton.

Arsenic.—99/100%, £35 per ton, ex store.

Barium Chloride.—98/100%, prime white crystals, £11 10s. to £13 per ton, bag packing, ex works; imported material would be dearer.

Bleaching Powder.—Spot, 35/37%, £10 7s. 6d. per ton in casks, special terms for contract.

Borax, Commercial.—Granulated, £26; crystals, £27; powdered, £27 10s.; extra fine powder, £28 10s.; B.P. crystals, £35; powdered, £35 10s.; extra fine, £36 10s. per ton for ton lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £73; powder, £74 per ton in tin-lined cases for home trade only, packages free, carriage paid.

Boric Acid.—Commercial, granulated, £42 10s.; crystals, £43 10s.; powdered, £44 10s.; extra fine powder, £46 10s.; large flakes, £55; B.P. crystals, £51 10s.; powdered, £52 10s.; extra fine powdered, £54 10s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

Calcium Bisulphite.—£6 10s. to £7 10s. per ton f.o.b. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton ex store.

Charcoal Lump.—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

Chlorine, Liquid.—£21 7s. 6d. per ton, d/d in 16/17 cwt. drums (3-drum lots); 5½d. per lb. d/d station in single 70-lb. cylinders.

Chrometan.—Crystals, 5½d. per lb.; liquor, £24 10s. per ton d/d station in drums.

Chromic Acid.—1s. 2d. per lb., less 2½%; d/d U.K. GLASGOW: 1s. 0½d. per lb. for 1 cwt. lots.

Citric Acid.—1s. 2d. per lb. MANCHESTER: 1s. 6d.

Copper Sulphate.—About £29 10s. per ton f.o.b. MANCHESTER: £29 10s., less 2%, in 5 cwt. casks f.o.b. Liverpool.

Cream of Tartar.—100%, 26s. per cwt., less 2½%, d/d in sellers' returnable casks.

Formaldehyde.—£21 15s. to £25 per ton d/d. MANCHESTER: 40%, £22 to £25 per ton in casks d/d; imported material dearer.

Formic Acid.—85%, £47 per ton for ton lots, carriage paid; smaller parcels quoted up to 50s. per cwt., ex store.

Glycerine.—Chemically pure, double distilled 1260 s.g., in tins, £3 15s. to £1 15s. per cwt., according to quantity; in drums, £3 7s. 6d. to £1 1s. Refined pale straw industrial, 5s. per cwt., less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 6s. 3½d. to 8s. 9½d. carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 6d. per lb.

Iodine.—Resublimed B.P., 9s. 11d. to 13s. 11d. per lb., according to quantity.

Lactic Acid.—Dark tech., 50% by vol., £37 10s. per ton; 80% by weight, £79; pale tech., 50% by vol., £44; 80% by weight, £86. Not less than one ton lots ex works; barrels returnable, carriage paid.

Lead Acetate.—White, £48 to £52 ton lots. MANCHESTER: £46 to £48 per ton.

Lead Nitrate.—About £45 10s. per ton d/d in casks.

Lead Red.—English, 5/10 cwt., £43 10s.; 1 cwt. to 1 ton, £13 5s.; 1/2 tons, £43; 2/5 tons, £42 10s.; 5/20 tons, £42; 20/100 tons, £41 10s.; over 100 tons, £41 per ton, less 2½ per cent., carriage paid; non-setting red lead 10s. per ton dearer in each case.

Lead White.—Dry English, less than 5 tons, £55; 5/15 tons, £51; 15/25 tons, £50 10s.; 25/50 tons, £50; 50/200 tons, £49 10s. per ton, less 5 per cent., carriage paid; Continental material, £1 per ton cheaper. Ground in oil, English, 1/5 cwt., £63 10s.; 5/10 cwt., £62 10s.; 10 cwt. to 1 ton, £62; 1/2 tons, £60 10s.; 2/5 tons, £59 10s.; 5/10 tons, £57 10s.; 10/15 tons, £56 10s.; 15/25 tons, £56; 25/50 tons, £55 10s.; 50/100 tons, £55 per ton, less 5 per cent., carriage paid.

Litharge.—1 to 2 tons, £43 per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 15s. to £22 15s. per ton.

Magnesium Chloride.—Solid (ex wharf), £12 to £13 per ton. MANCHESTER: £13 to £14 per ton.

Magnesium Sulphate.—Commercial, £10 to £12 per ton, according to quality, ex works.

Mercury Products.—Controlled price for 1 cwt. quantities: Bichloride powder, 11s. 7d.; bichloride lump, 12s. 2d.; ammon. chloride powder, 13s. 5d.; ammon. chloride lump, 14s.; mercurous chloride, 13s. 9d.; mercury oxide red cryst., B.P., 15s.; red levig. B.P., 15s. 6d.; yellow levig. B.P., 14s. 9d.; yellow red, 14s. 4d.; sulphide, red, 12s. 11d. **Methylated Spirit.**—Industrial 66° O.P. 100 gals., 2s. 4d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

Nitric Acid.—£23 to £31 per ton ex works.

Oxalic Acid.—From £60 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

Paraffin Wax.—Nominal.

Potash, Caustic.—Basic price for 50-100 ton lots. Solid, 88/92%, commercial grade, £53 15s. per ton, c.i.f. U.K. port, duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement.

Potassium Bichromate.—Crystals and granular 8d. per lb.; ground 7d. per lb., carriage paid.

Potassium Carbonate.—Basic prices for 50 to 100 ton lots; hydrated, 83/85%, £46 17s. 6d. per ton; calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £3 10s. extra per ton.

Potassium Chlorate.—Imported powder and crystals, ex store London, 2s. per lb.

Potassium Iodide.—B.P., 8s. 8d., to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, £40 to £45 per ton ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 8½d. per lb. for 1 cwt. lots; for 3 cwt. and upwards 1s. 8d. per lb.; technical, £7 15s. 3d. to £8 9s. 6d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, about 1s. 9d. to 1s. 11d. per lb., supplies scarce.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

Soda, Caustic.—Solid, 76/77% spot, £14 17s. 6d. per ton d/d station.

Soda Crystals.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

Sodium Acetate.—£10 per ton, ex wharf.

Sodium Bicarbonate (refined).—Spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 5½d. per lb., anhydrous, 6d. per lb., net d/d U.K.

Sodium Bisulphite Powder.—60/62%, £17 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£36 to £45 per ton, d/d, according to quantity.

Sodium Hyposulphite.—Pea crystals, £19 15s. per ton for 2-ton lots; commercial £14 15s. per ton. MANCHESTER: Commercial, £14 10s.; photographic, £19 15s.

Sodium Iodide.—B.P., for not less than 28 lb., 9s. 6d. per lb.; for not less than 7 lb., 13s. 1d. per lb.

Sodium Metasilicate.—£15 15s. per ton, d/d U.K. in cwt. bags.

Sodium Nitrate.—Refined, £13 10s. per ton for 2-ton lots d/d.

Sodium Nitrite.—£24 10s. per ton for ton lots.

Sodium Perborate.—10%, £5 2s. per cwt.

Sodium Phosphate.—Di-sodium, £17 per ton d/d for ton lots.

Tri-sodium, £22 per ton d/d for ton lots.

Sodium Prussiate.—From 7½d. per lb. ex store.

Sodium Silicate.—£9 15s. per ton, for 4-ton lots.

Sodium Sulphate (Glauber Salts).—£4 10s. ton d/d.

Sodium Sulphate (Salt Cake).—Unground. Spot £4 8s. 6d. per ton d/d station in bulk. MANCHESTER: £4 13s. 6d. per ton d/d station.

Sodium Sulphide.—Solid 60/62%. Spot, £17 15s. per ton d/d in drums; crystals, 30/32%, £12 12s. per ton d/d in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; Pea crystals, spot, £18 10s. per ton d/d station in kegs; commercial, £12 15s. per ton d/d station in bags.

Sulphur.—Finely powdered, £19 per ton d/d; precip. B.P., 68s. per cwt.

Sulphuric Acid.—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw., arsenious, £4 3s. 6d. per ton. Quotations naked at sellers' works.

Tartaric Acid.—3s. 1d. to 3s. 3½d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 3s. 3d. per lb.

Zinc Oxide.—Maximum prices: White seal, £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d buyers' premises.

Zinc Sulphate.—Tech., about £20, carriage paid, casks free.

Rubber Chemicals

Antimony Sulphide.—Golden, 11½d. to 2s. per lb. Crimson, 1s. 10d. to 2s. 2d. per lb.

Arsenic Sulphide.—Yellow, 1s. 10d. to 2s. per lb.

Barytes.—Best white bleached, £8 3s. 6d. per ton.

Cadmium Sulphide.—5s. 9d. to 6s. 6d. per lb.

Carbon Black.—5½d. to 8½d. per lb., according to packing.

Carbon Bisulphide.—£33 5s. to £38 5s. per ton, according to quantity, in free returnable drums.

Carbon Tetrachloride.—£46 to £49 per ton.

Chromium Oxide.—Green, 1s. 6d. per lb.

India-rubber Substitutes.—White, 5 15/16d. to 8½d. per lb.; dark, 5 9/16d. to 6 3/16d. per lb.

Lithopone.—30%, £25 per ton; 60%, £31 to £32 per ton. Imported material would be dearer.

Mineral Black.—£10 to £14 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£15 per ton.

Vermilion.—Pale or deep, 13s. per lb., for 30-lb. lots.

Plus 5% War Charge.

Nitrogen Fertilisers

Ammonium Phosphate Fertilisers.—Type B, £13 18s. 9d. per ton in 6-ton lots, d/d farmer's nearest station in September.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station: September delivery, £9 13s. Increase of 1s. 6d. per ton for every month up to £10 0s. 6d. in February, 1942; March/June, 1942, £10 2s. Rebate per ton on future deliveries: October, 10s.; November, 6s.; December, 2s.

Calcium Cyanamide.—Nominal; supplies very scanty.

Concentrated Complete Fertilisers.—£14 8s. 9d. per ton in 6-ton lots, d/d farmer's nearest station in September. Supplies small except C.C.F. Special.

"Nitro Chalk."—£9 11s. per ton in 6-ton lots, d/d farmer's nearest station in September.

Sodium Nitrate.—Chilean super-refined for 6-ton lots d/d nearest station, £15 per ton; granulated, over 98%, £14 10s. per ton. Surcharges for smaller quantities unless collected at warehouse or depots.

Coal Tar Products

Benzol.—Industrial (containing less than 2% of toluol), 2s. to 2s. 2d. per gal., ex works.

Carbolic Acid.—Crystals, 9½d. to 10½d. per lb.; Crude, 60°s 3s. 3d. to 4s. 6d., according to specification. MANCHESTER: Crystals, 10½d. per lb., d/d; crude, 3s. 10d. to 4s. 1d., naked, at works.

Creosote.—Home trade, 5½d. to 7d. per gal., f.o.r., maker's works; exports 6d. to 6½d. per gal., according to grade. MANCHESTER: 5½d. to 7½d. per gal.

Cresylic Acid.—Pale, 99/100%, 3s. per gal. MANCHESTER: Pale, 99/100%, 4s. 3d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 4d. to 2s. 8d. per gal.; Heavy 90/190°, 1s. 10½d., naked at works. MANCHESTER: 90/160°, 2s. 6d. to 2s. 9d.

Naphthalene.—Crude, whizzed or hot pressed, £14 per ton; purified crystals, £23 per ton in 2-cwt. bags; flaked, £27 per ton. Fire-lighter quality, £7 10s. to £9 10s. per ton ex works. MANCHESTER: Refined, £27 per ton.

Pitch.—Medium, soft, nominal, f.o.b. MANCHESTER: Nominal.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 14s. to 18/180°, 4s. to 5s. per gal., f.o.b. MANCHESTER: 14s. to 18s. 6d. per gal.

Toluol.—Pure, 2s. 5d. nominal. MANCHESTER: Pure, 2s. 5d. per gal. naked.

Xylol.—Commercial, 3s. 7d. per gal.; pure, 3s. 9d. MANCHESTER: 3s. 4d. to 3s. 10d. per gal.

Wood Distillation Products

Calcium Acetate.—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £23.

Methyl Acetone.—40.50%, £54 per ton.

Wood Creosote.—Unrefined, 2s. per gal., according to boiling range.

Wood Naphtha, Miscible.—4s. 6d. to 5s. per gal.; solvent, 5s. per gal.

Wood Tar.—£4 to £5 per ton, according to quality.

Intermediates and Dyes (Prices Nominal)

m-Cresol 98/100%.—Nominal.

o-Cresol 30/31° C.—Nominal.

p-Cresol 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb.; 66/68° C., 1s.

***p*-Nitraniline.**—2s. 5d. per lb.

Nitrobenzene.—Spot, 5½d. per lb., in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.

Nitronaphthalene.—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.

***o*-Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.

***p*-Toluidine.**—2s. 2d. per lb., in casks.

***m*-Xyldine Acetate.**—1s. 5d. per lb., 100%.

Latest Oil Prices

LONDON.—September 3.—For the period ending September 27 per ton, net, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies:—LINSEED OIL, raw, £41 10s. RAPESEED OIL, crude, £44 5s. COTTONSEED OIL, crude, £31 2s. 6d.; washed, £34 5s.; refined edible, £35 12s. 6d.; refined deodorised, £36 10s. SOYA BEAN OIL, crude, £33; refined deodorised, £37. COCONUT OIL, crude, £28 2s. 6d.; refined deodorised, £31 7s. 6d. PALM KERNEL OIL, crude, £27 10s.; refined deodorised, £30 15s. PALM OIL, refined deodorised, £37; refined hardened deodorised, £41. GROUNDNUT OIL, crude, £35 10s.; refined deodorised, £40. WHALE OIL, crude hardened, 42 deg., £30 10s.; refined hardened, 42 deg., £33. ACID OILS.—Groundnut, £19; soya, £17; coconut and palm kernel, £22 10s. ROSIN, 32s. to 42s. per cwt., ex wharf, according to grade. TURPENTINE, spot, American, nominal.

LIVERPOOL.—September 2.—TURPENTINE, spot, American, nominal.

COMPANY MEETING

Beecham's Pills, Ltd.

Mr. Philip Hill's Speech

Increased Trading Profit

The thirteenth annual general meeting of Beechams Pills, Ltd., was held in London on Thursday, August 28, Mr. Philip E. Hill, the chairman, presiding.

The Chairman said: For the ninth successive year our trading profits show an increase. The profit for the year amounts to £1,085,893, which is comparable with £1,055,615 for the preceding year. This figure is arrived at after providing in the accounts of two of the subsidiary companies £97,758 for the redemption of redeemable preference shares (you will appreciate that this cost the company, including tax, some £195,000). In addition, we have increased our reserves and carry-forwards in the accounts of subsidiary companies. Moreover, we have not raised our selling prices since the outbreak of war, although our costs of production and overheads during the year under review have increased by nearly £350,000 as compared with 1939, so I am sure you will agree that when all these things are taken into consideration, we have every reason to be satisfied with the results achieved.

The company's normal trade both at home and overseas, without accounting for Government contracts, shows considerable expansion. Our export trade has, of course, been handicapped by war conditions, although we are exceedingly fortunate that the development of this part of our business lies within the Empire and North and South America. Our report and accounts indicate that our contribution to the national exchequer for the year is estimated to amount to over £1,000,000.

Abolition of Medicine Stamp Duty

Since we last met, Parliament has passed the Pharmacy and Medicines Act, 1941, one of the results of which will be the

abolition of the Medicine Stamp Duty, as and from September 2, which, as far as this company is concerned, amounted last year to £166,000. Generally, it is hoped that the new Act will improve the status of proprietary articles and patent medicines. The directors have decided that the full benefit of the savings effected as a result of the passing of this Act shall be given to the public.

Your board came to the conclusion at the outbreak of war that it would be advisable to carry as large stocks as possible, and in pursuance of this policy, they have (as shown by the balance sheet) increased the bank loans.

It is no easier to forecast the future to-day than it was a year ago, but it is necessary to issue a word of warning and that is—if costs of production continue to increase, we shall ultimately be bound to raise selling prices.

New Acquisitions to the Board

Whatever the future may have in store for us, we can be more than ever satisfied that our widespread developments have established our business on a sound basis, and we can not only congratulate ourselves on the fact that our recent purchases and acquisitions have been remunerative, but in obtaining the services and association of Mr. Lazell, Mr. Dunbar and Mr. Fabricius, we have added considerably to the ability of the company's executive, and all these gentlemen have joined the board since our last meeting.

The chairman concluded by moving the adoption of the report and accounts.

Mr. J. Stanley Holmes, M.P. (managing director), seconded the resolution, and it was carried unanimously.

A vote of thanks to the chairman, directors, and staff was carried with acclamation.

Chemical and Allied Stocks and Shares

ALTHOUGH business in most sections of the Stock Exchange has been on a moderate scale, the general undertone was firm, and individual features of interest were not lacking. There was, in fact, again little profit-taking, despite the rise in security values shown in recent weeks, and in some directions further gains were recorded. There were continued indications that the apparently satisfactory yields still obtainable on various leading industrial securities were attracting further attention in cases where the prevailing view is that dividend payments may be little changed and where there are also considered to be good possibilities of increased earnings in the immediate post-war period. Many shares of companies associated with the chemical and kindred industries are being included in this category, and where prices were changed, movements, although moderate in character, have been in favour of holders.

Imperial Chemical at 31s. 10½d., were 7½d. better as compared with a week ago, and the 7 per cent. preference units were a few pence higher at 32s. 9d. Fison Packard had a steady appearance at 33s. 9d., while B. Laporte were again around 61s., and Borax Consolidated held their recent improvement to 29s. The units of the Distillers Co. were again firm at 68s. 6d., the assumption being that there is a reasonable change of the dividend being maintained around last year's rate of 16½ per cent. United Molasses at 26s. 9d. were also a firm feature, and British Match were again around 35s., while elsewhere, Dunlop Rubber ordinary units had a firm appearance at 35s. 6d. In other directions Greiff-Chemicals Holdings, which remained steady on satisfaction with the dividend, were 5s. 7½d. Lacrinoid Products 2s. shares transferred up to 1s. 9d., under the influence of the increase recently announced in the interim dividend, while pending the results for the past financial year, Erinoid 5s. shares were dealt in around 4s. Moreover, British Industrial Plastics 2s. shares transferred around 3s. 1½d.; in this case the financial results fall to be issued in November. There appears to be a tendency

in the market to give rather more attention to shares of companies connected with the plastics industry on the assumption that there may be considerable further expansion in the latter after the war, arising from new developments and extension in the uses of plastics. Among other securities, Ilford ordinary shares received more attention and transferred around 29s. Lever and Unilever at 25s. 6½d. were unchanged on balance, awaiting publication of the full results for the past year's working. Hopes of better results maintained firmness in Imperial Smelting at 12s. 6d., while General R-fractions were 11s. compared with 10s. a week ago. Elsewhere, Murex were again firm at 59s., on market expectations that the dividend is likely to be unchanged. Prospects of the dividend being maintained also kept a firm tendency in Tube Investments ordinary, which were 94s. 0d., but elsewhere there was a slightly easier trend in various iron and steel securities, including United Steel and Stewarts and Lloyds, although the greater part of recent gains were held.

Although "ex" the unchanged interim dividend, British Oxygen at 66s. 10½d. were within 7½d. of the price ruling a week ago. British Aluminium remained at 47s. 6d., and Birmid Industries moved higher at 66s. Triplex Glass were slightly lower at 22s. 6d., awaiting the forthcoming dividend announcement, and among other shares, Barry and Staines at 36s. kept all their recent further rise. Naim and Greenwich were 61s. 3d. compared with 58s. 9d., and pending the results, Wall Paper Manufacturers deferred units recorded a further gain from 25s. 9d. to 26s. 6d. British Glues and Chemicals 4s. shares maintained their recent rise to 6s. 3d., while Pinchin Johnson at 23s. were moderately better. Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. British Drug Houses have kept around 23s. Boots Drug were steady at 35s. 6d. as were Beechams Pills deferred shares at 9s. 6d. Anglo-Iranian and other leading oil shares were again better on balance.

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